REMARKS

Reconsideration and allowance are respectfully requested in light of the above amendments and the following remarks.

Claims 15 and 17-21 have been amended for clarity. Thus, no estoppel is deemed attachable to the amendments.

Claims 15 and 17-21 stand rejected, under 35 USC §102(e), as being anticipated by Sunaga (US 6,381,233). Claim 16 stands rejected, under 35 USC §103(a), as being unpatentable over Sunaga in view of Ziv et al. (US 5,867,527). The Applicant respectfully traverses the rejections.

A feature of the claimed invention, as recited in independent claims 15 and 18-20, is to: (1) spread a known signal, (2) break down the known signal, after the spreading, to the same number of chips as the spreading factor, and (3) frequency division multiplex (FDM) each one of these chips to a different subcarrier frequency, so that the chips are aligned in a frequency axis direction (i.e., frequency diversified). Thereafter, the frequency division multiplexed chips constituting the known signal are transmitted simultaneously. Another feature of the claimed invention, as recited in independent claims 17-19 and 21, is to: (1) receive a frequency division multiplexed known signal of the type described above, (2) detect a residual phase

error using the received known signal, and (3) compensate another received signal using the detected residual phase error.

The above-described features provide the advantage of achieving the effect of frequency diversity for a known signal. Due to this frequency diversity, residual phase errors may be detected with a high degree of accuracy in a fading environment where some subcarriers (i.e., frequencies) have a low reception level. In other words, although some subcarrier frequencies carrying chips of the FDM known signal may experience high levels of intermittent interference (e.g., fading), most subcarrier frequencies will not. As a result, the few incorrectly received chips may be regenerated through an error correction technique so that the known signal may be reconstituted. Once the known signal is reconstituted, it may be used detect residual phase errors so that information signals, accompanying the transmitted known signal, may be better received.

Moreover, the above-noted feature of spreading a known signal in a frequency axis direction (i.e, frequency diversity) provides the advantage of reducing the time for residual phase error detection and the requisite memory capacity at the receiving end.

By contrast to the above-noted claimed features, Sunaga discloses spreading a pilot signal in a time axis direction

(i.e., time diversity). As noted above, the present invention is configured to frequency division multiplex a known signal and spread the known signal in a frequency axis direction (i.e., frequency diversity). This is achieved by breaking down the known signal into a number of chips that is the same as the spreading factor and assigning each chip to a different subcarrier of the FDM signal transmitted by the transmission apparatus. Sunaga teaches nothing similar to this.

Moreover, for Sunaga's system to despread a known signal at the receiver, the receiver must receive a number of OFDM symbols that is equal to the spreading factor. For example, if the spreading factor is 64, Sunaga's receiver must receive 64 OFDM symbols before it can despread the received signal, having a spreading factor of 64, and thereby reconstitute the known signal transmitted by the transmitter. By contrast, the claimed invention spreads the known signal in a frequency axis direction and transmits all components of the known signal simultaneously. Therefore, the receiver needs only to receive one OFDM symbol to despread the known signal transmitted by the transmitter. For a spreading factor of 64, the amount of time the claimed invention requires for residual phase error detection is 1/64 of that required by Sunaga's system. Thus, the claimed invention reduces the time required for residual phase error detection to

1/spreading-factor compared to Sunaga's system. Additionally, for a CDMA communication scheme, the claimed invention reduces the time required to acquire initial synchronization to 1/spreading-factor compared to Sunaga's system.

As mentioned previously, since Sunaga's system spreads the known signal in a time axis direction, such that each time-spread portion of the known signal is transmitted at a different time, the same number of OFDM symbols as the spreading factor need to be received for residual phase error detection to be performed. As a result, Sunaga's system must store, for a single known signal, the same number of OFDM symbols as the spreading factor in a memory. For the known signals communicated over multiple subcarriers, Sunaga's system must store in a memory a number of received signals equal to the mathematical product of the spreading factor and the number of subcarriers. Consequently, the memory capacity and processing delay for Sunaga's receiver increase in proportion to the spreading factor.

Since the claimed invention spreads a known signal in a frequency axis direction and transmits components of the known signal simultaneously, residual phase error detection requires only one OFDM symbol and the memory capacity and processing delay at the receiver is 1/spreading-factor compared to Sunaga's system.

In accordance with the above discussion, the Applicant submits that Sunaga does not disclose the above-noted subject matter defined by independent claims 15 and 17-21. More specifically, Sunaga does not disclose the combined features recited in claims 15, and 18-21 of: (1) spreading a known signal, (2) breaking down the known signal, after the spreading, to the same number of chips as the spreading factor, and (3) frequency division multiplexing each one of these chips to a different subcarrier frequency, so that the chips are aligned in a frequency axis direction (i.e., frequency diversified). Sunaga also does not disclose receiving a frequency diversified known signal of this type for use in residual phase error detection, as recited in claims 17-19 and 21. Therefore, allowance of independent claims 15 and 17-21 and dependent claim 16 is warranted.

Ziv does not cure any of the above-described deficiencies of Sunaga, and thus, all pending claims are allowable over these references, whether considered alone or together.

In view of the above, it is submitted that this application is in condition for allowance and a notice to that effect is respectfully solicited.

If any issues remain which may best be resolved through a telephone communication, the Examiner is requested to telephone

the undersigned at the local Washington, D.C. telephone number listed below.

Respectfully submitted,

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